RSV, Cellulitis and Acute Otitis; OH MY!

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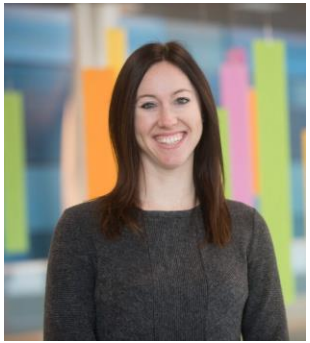

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Disclosures/Conflict of Interest

- None to report

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YOU HAVE PINK EYE, LICE & COVID-19
BUT NOT THE FLU...YET.

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Viral respiratory infections

- Bronchiolitis/LRTI/Croup/Pneumonia/viral URI
  - RSV, REV, HMPV, SARS-CoV-2, OG Coronaviruses, Adenovirus, Parainfluenza, Influenza
  - RFA vs 4-plex- is this necessary?
    - To rule out COVID, can obtain only SARS-CoV-2 to help guide management
      - Remdesivir, Steroids if requiring O2/ventilation
    - Can also obtain Influenza and RSV panel only
      - Tamiflu vs supportive care

Viral respiratory infections

- Transmission
  - Contact, droplet, airborne
  - WASH YOUR HANDS, anticipatory guidance to families
  - Incubation period 24-72 hours for most common cold viruses
  - Children 6 and younger have an average of 6-8 colds per year
- Seasonal patterns typically
  - COVID ruined this…
  - Worst influenza season this year 2024-2025 in 15 years
  - RSV + in Summer-time which is typically October-March, but is returning to pre-pandemic seasonality

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Viral respiratory infections

- RSV
  - Causes Bronchiolitis in children younger than 2 years; LRTI and URI in > 2 years
    - Rhinorrhea/URI progressing to LRTI with wheezing/crackles
    - Day 3-5 +/- 7 is peak (typically longer courses in premature and younger infants)
  - Supportive care
    - Suctioning, smaller more frequent feeds, IV/NG fluids, humidifier, supplemental O2, HFNC, antipyretics for fever/comfort

Viral respiratory infections

- RSV
  - Little evidence to suggest use of Albuterol
    - If trialed for distress, do they respond?
      - Keep on chart for future (WARI)

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Viral respiratory infections

- Monoclonal antibody Nirsevimab/Beyfortus
  - All infants < 8 months born during respiratory season (typically October-March) or entering 1st RSV season – single dose
    - Protection for 5 months
      - CDC study done between 2023-2024 showed 90% effective at preventing RSV-associated hospitalization in infants during their 1st RSV season
  - If during pregnancy, mom received RSV vaccine, baby not eligible, except if RSV vaccine given within 14 days prior to birth
    - >8 months of age <19 months, can give 2nd dose if hx BPD, CF, immunocompromised

Viral respiratory illnesses

- Human rhino/enterovirus
  - “Common cold”
  - Can cause bronchiolitis/URI/LRTI
    - Cough, rhinitis, sneezing, fever, HA
  - Supportive care
  - Can be + on RFA for a while (personal experience)

Viral respiratory illnesses

- Human metapneumovirus
  - Can cause pneumonia and bronchiolitis/URI/LRTI
    - Cough, rhinitis, fever, wheezing
    - Supportive care

Viral respiratory illnesses

- SARS-CoV-2
  - Severe acute respiratory distress syndrome (SARS) or COVID-19
    - Fever, cough, SOB, myalgias, HA, ST, rhinorrhea, N/V, diarrhea, loss of taste/smell or food aversion/difficulty feeding in young children
    - Can be a wide range of symptoms from mild to severe
    - Long COVID
    - COVID vaccine

Viral respiratory illnesses

- OG Common Cold Coronaviruses
  - 229E, OC43, NE63, HKU1
    - 1/3 community acquired URIs
  - Can cause URI, pneumonia and croup
    - Supportive care

Viral respiratory illnesses

- Adenovirus
  - Typically includes high fever, conjunctivitis, eye drainage, pharyngeal erythema, preauricular lymphadenopathy
  - Very contagious URI
    - Can also cause tonsilitis and pneumonia
    - Supportive care

Viral respiratory illnesses

- Parainfluenza (types 1-4)
  - Most common cause of Croup (upper airway)
    - Barky cough, stridor, hoarse voice
    - Racemic epinephrine, Decadron (0.6 mg/kg, max 16 mg), heliox/PICU
    - Soft tissue neck imaging if concerned for foreign body or bacterial infection if unvaccinated
    - Can also cause LRTI/bronchiolitis and pneumonia

Viral respiratory illnesses

- Influenza A & B
  - Seasonal Vaccination
    - 6 months-adults
      - First dose is 2 series 4 weeks apart
  - Can cause pneumonia and croup
  - Fever, cough, rhinitis, HA, myalgia, myositis
    - Tamiflu BID x 5 days (dosing weight dependent), given within 48 hours of start of symptoms, may also give later in course if hospitalized
      - Can lessen symptoms and length of illness

Viral respiratory illnesses

- Rhino, adeno, influenza and enteroviruses
  - Produce lasting immunity from these viruses, however so many serotypes exist, this does little to prevent subsequent colds
    - Although, when you typically have 1 respiratory virus in a “season” the likelihood of getting it a 2nd time in a season is rare

Viral respiratory illnesses

- RSV, Parainfluenza and coronaviruses
  - Do not produce lasting immunity
  - Reinfection can occur, but subsequent infections are generally milder and shorter duration

Viral respiratory illness

- When to return to clinic/ED?
  - Distress
  - Return of fever if fever free
- When to return to school/daycare
  - Fever free 24 hours without use of medication
  - Cough will last up to 4 weeks- not a reason to stay home

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Bordetella Pertussis

- Cases increased by 500% from 2023-2024
- Vaccination is best prevention
  - DTaP at 2, 4, 6, 15 months, 4 years
  - Tdap preteens, adults, pregnant women
- Tested with ACH Respiratory Film Array
- Starts with typical URI symptoms, but later stage is severe, persistent coughing fits
  - Whooping sound post coughing fit
  - 100-day cough
- Treatment with Macrolides (Azithromycin, Erythromycin) or can use Bactrim

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SUPERIMPOSED BACTERIAL INFECTIONS

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Pathophysiology

- Viral infection impairs mucosal and ciliary clearance of normal nonpathogenic bacteria, which enables particular bacteria to flourish and causes invasive infections
  - Pneumonia, AOM, Sinusitis
  - Much overlap between the three
- Prevention: vaccination, antiviral medications

Pneumonia

- Viral is most common type of pneumonia
  - Influenza and RSV
- Viruses associated with secondary bacterial pneumonia
  - Influenza, parainfluenza, adenovirus, human metapneumovirus, measles, RSV, rhinovirus, coronavirus
- Regardless of the infecting virus, causal agents of secondary bacterial pneumonia reflect colonizing nasopharyngeal flora
- Bacterial pneumonia
  - Leading cause of death worldwide
  - Can happen via community/hospital acquired or secondary infection following virus

Bacterial Pneumonia

- Most common bacterial cause: Streptococcus pneumonia
  - H. flu, Moraxella
  - Infections still occur despite immunization
- Influenza and other respiratory viruses predispose to a more severe clinical course

Mycoplasma pneumonia

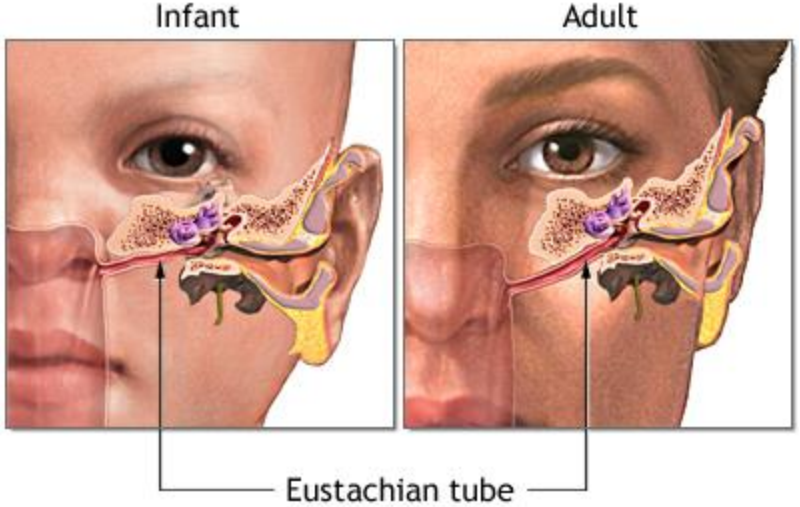
- Surge 2023-24 after low infection rates during Covid pandemic
  - Social distancing causing lack of exposure to mycoplasma
  - Mutations in the bacteria, making it more infectious to populations not typically at risk (i.e. toddlers)
  - Cyclical outbreak patterns

Mycoplasma pneumonia

- School aged and teens at risk
  - Current outbreak affecting young children
  - AKA Walking Pneumonia
- Outbreaks prolonged due to long incubation period, 1-4 weeks
- Not treated by penicillin; lack a cell wall which is different than other pathogens

Otitis Media

- < 2 years at highest risk due to:
  - Eustachian tubes smaller and horizontal making difficult to drain fluid
  - Developing immune system, normal for 8-12 viral infections annually
- Most common bacterial cause: Strep pneumonia, H. flu, Moraxella
- “Watchful waiting”: >2 years, unilateral infection, temp <39, symptoms <72 hours at presentation



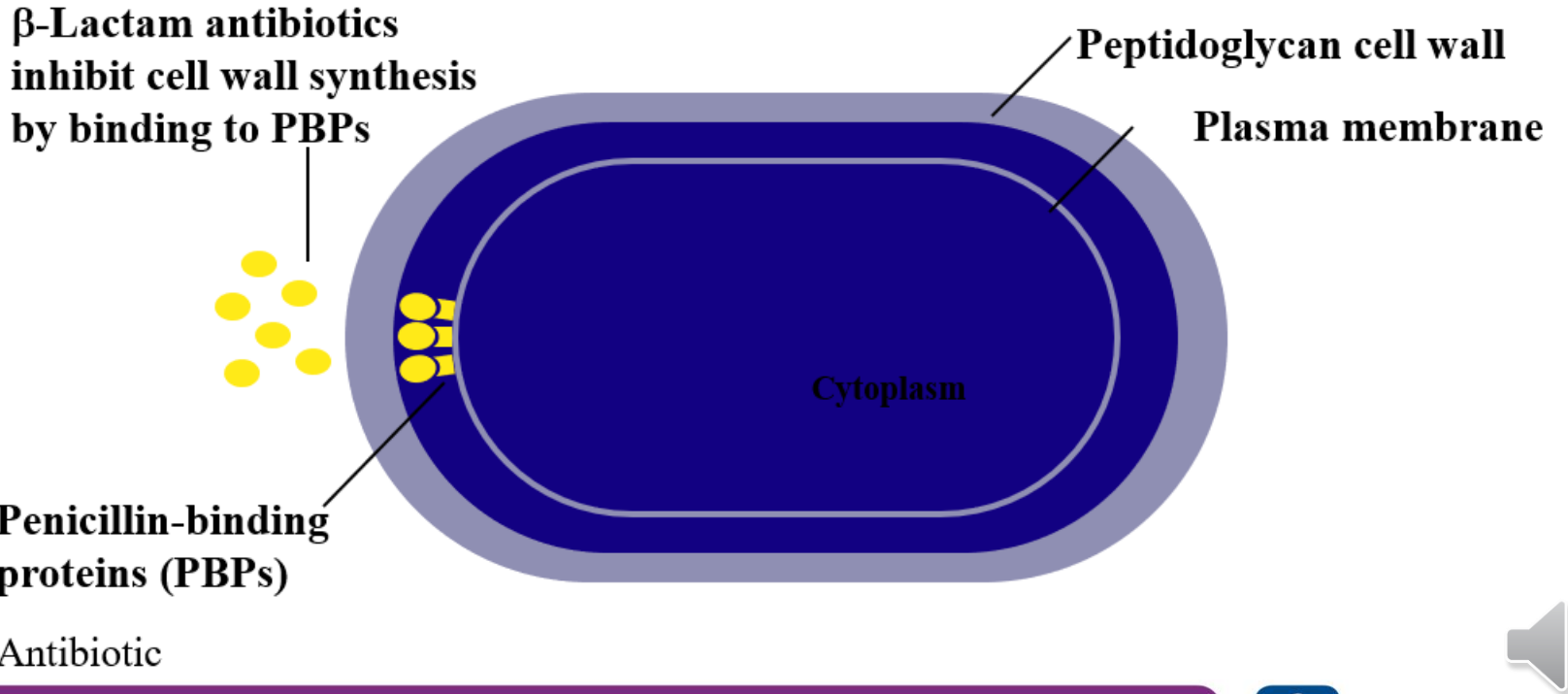
Sinusitis

- Infection of one or more of the paranasal sinuses
  - Associated with the “common cold”, resolves without treatment in 7-10 days
- Bacterial versus viral, distinction is important to prevent unnecessary antibiotics!
- Bacterial: Fever >3 days, worsening with time, or symptoms >10 days without improvement, onset of new fever or headache
- Common pathogens: no surprises! Same as pneumonia!
  - Strep pneumo, H. Flu, Moraxella

Treatment

- High dose versus standard Amoxicillin dosing
  - 90 mg/kg/day for ears, lungs, sinus
    - No increase in side effects
  - 50 mg/kg for GAS
- Streptococcus pneumonia has resistance to penicillin binding protein
  - Increase dose of amoxicillin to overcome!
- When to add clavulanic acid? (Augmentin)
  - H. flu and Moraxella
  - AOM with bacterial conjunctivitis, more likely H. flu, Moraxella, or resistant strep pneumo

Primary Killing Mechanism of β-Lactam Antibiotics



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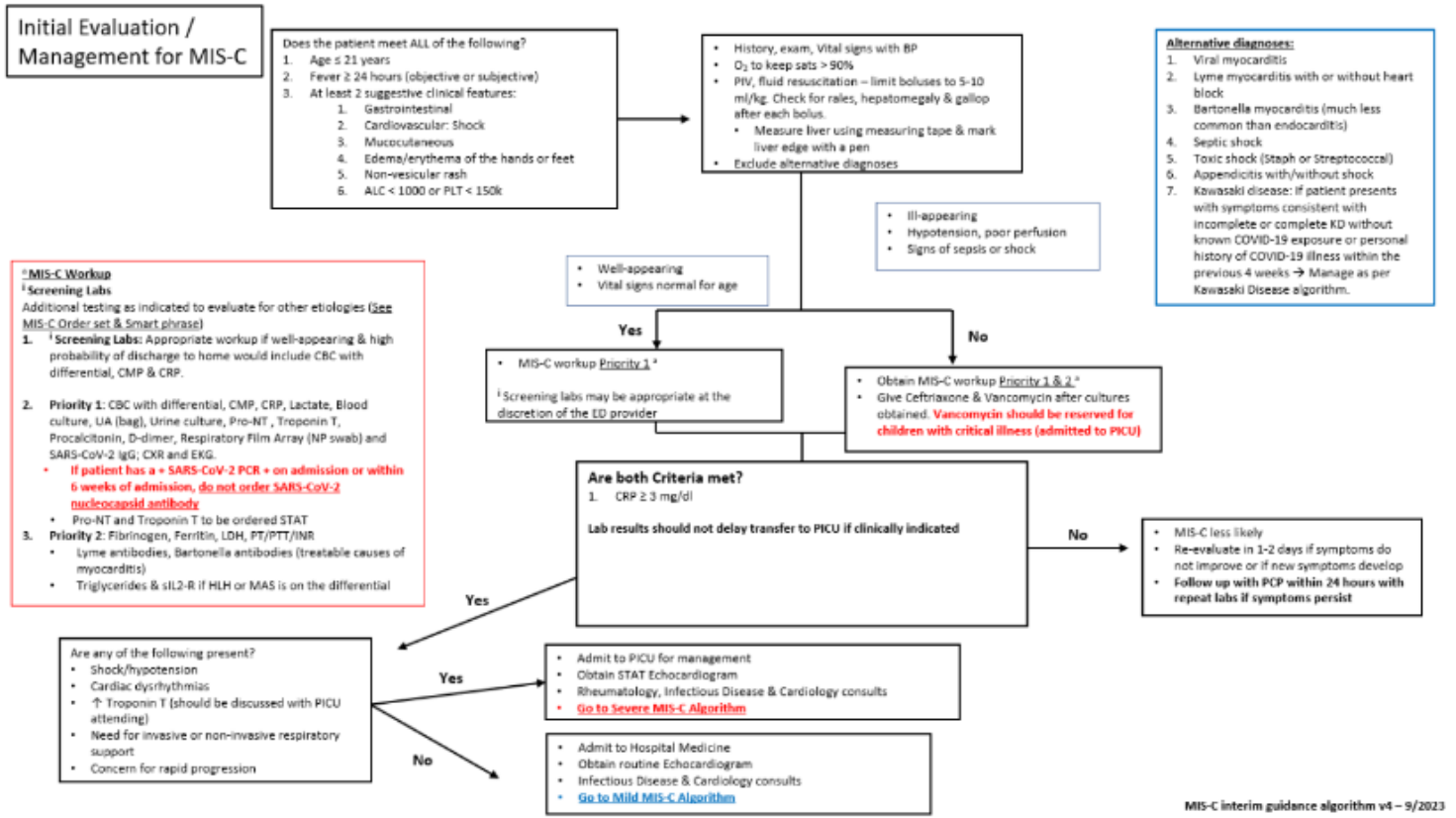
Beta Lactam Antibiotics

- Bacterial resistance estimated
  - 50% H. flu
  - 100% Moraxella
  - 50% Streptococcus Pneumonia
- H. flu and Moraxella resistant via beta lactamase
  - Overcome with clavulanic acid!
- Strep. Pneumonia resistant by altering penicillin binding sites
  - Overcome with high dose, increasing MIC

MIS-C

- Serious condition post COVID similar to Kawasaki disease
  - Persistent fever 4-6 days, conjunctivitis + mucous membrane involvement, rash, GI symptoms, lymphadenopathy, edema hands/feet
  - IVIG, steroids, GI prophy, Aspirin
    - Follow up with ID and Cardiology

MIS-C: Diagnostic and Management Guidelines:



MIS-C interim guidance algorithm v4 – 9/2023

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Mild MIS-C Management

Mild MIS-C
- No vasoactive support
- Minimal to no respiratory support
- Mild to no organ dysfunction

Admit to HM service
If transferred from an outside facility, see "Initial Evaluation & Management"
1. CRM, continuous pulse ox monitoring
2. IVIG 2 grams/kg (max 100 grams) over 12 to 18 hours
3. Methylprednisolone 2mg/kg/day IV divided every 8 hours †
4. Aspirin 3-5 mg/kg/dose PO daily
   - If weight ≤ 15kg, 40.5mg PO daily
   - If weight > 15kg, give 81mg PO daily
5. GI Prophylaxis while on steroids and aspirin
6. Repeat CRP (all patients) and BNP (if elevated on admission) 1-2 days after IVIG
   - The remaining MIS-C workup obtained on admission do not need to be repeated unless there's concern for clinical decline.

Refractory to treatment? ‡

Yes
- Repeat CRP, CBC with diff, Pro-NT BNP, CMP, Troponin T, Procalcitonin, D-dimer
- Proceed to Severe MIS-C algorithm

No
- Afebrile > 24 hours
- Downtrending CRP
- Tolerating PO

- Stop IV Steroids
- Start Prednisone or Prednisolone 2mg/kg/day PO daily on day of discharge

Discharge criteria Met?
- Afebrile > 48 hours after completion of IVIG
- Most recent blood cultures without growth x 48 hours
- Tolerating enteral diet with home feeding plan
- Repeat CRP trending down
- Follow-up with ID & Cardiology scheduled
- Has medications in hand or ready to pick up at pharmacy prior to discharge

D/C Home
- Follow up with ID and Cardiology in 1-2 weeks with repeat Echo (schedule appointments prior to DC)
- Obtain BNP, CBC with diff and CRP at follow up
- Repeat BNP and Troponin T weekly if elevated
- Have medications in hand prior to discharge if possible
- GI Prophylaxis until weaned off steroids
- After visit summary provided to family
- Neuropsychology referral (outpatient)

Consider PICU transfer if:
- Tachycardia despite appropriate fluid boluses
- Hypotension
- Evidence of end organ dysfunction
- ‡Refractory MIS-C
  - Recurrence or persistence of fever > 36 hours after IVIG
  - Lack of clinical improvement; or development of severe end organ dysfunction
  - Lack of improvement in inflammatory markers (CRP)

Watcher status on admission: Required for ALL cases of MIS-C admitted to the floor for the 1st 8 hours

*Contact HM attending if considering PICU transfer

† Max Methylprednisolone daily dose (2mg/kg/day) is 60mg/day
‡ Max 20-30mg/kg/day = 1 gram

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Severe MIS-C Management

Severe MIS-C
- Vasoactive support needed
- Significant respiratory support (HFNC, invasive/non-invasive support)
- Concern for rapid clinical decline
- Moderate to severe organ dysfunction
- ECMO

→

Admit to PICU
- Continue broad-spectrum antibiotics until cultures negative x 48 hours
- IVIG 2 grams/kg (max 100 grams) over 12 to 18 hours
- GI Prophylaxis
- Methylprednisolone 30mg/kg/day IV daily x 3 days ‡, then 2 mg/kg/day IV daily†
- Enoxaparin 0.5mg/kg/dose SQ Q12H
  - Anti-Xa level 4 hours after the 2nd or 3rd dose
- Consult Hematology if bleeding concerns on anti-coagulants including:
  - PLT < 50k
  - Fibrinogen ≤ 75 mg/dl
  - PT ≥ 16 or PTT ≥ 44 sec
  - Severe renal injury
- If severe cardiac dysfunction present, start Anakinra 6mg/kg/day IV divided q6h with Rheumatology consultation [b]
- Daily labs: BNP (STAT), CRP, CBC, CMP, Procalcitonin
- If Troponin T elevated, repeat every 12 hours until decreasing
- Repeat echocardiogram and EKG frequency as directed by Cardiology

Refractory to treatment? [¢]

[¢] Refractory MIS-C
- Recurrence or persistence of fever >36 hours after IVIG
- Lack of clinical improvement
- Lack of improvement in inflammatory markers 2 days after IVIG completion

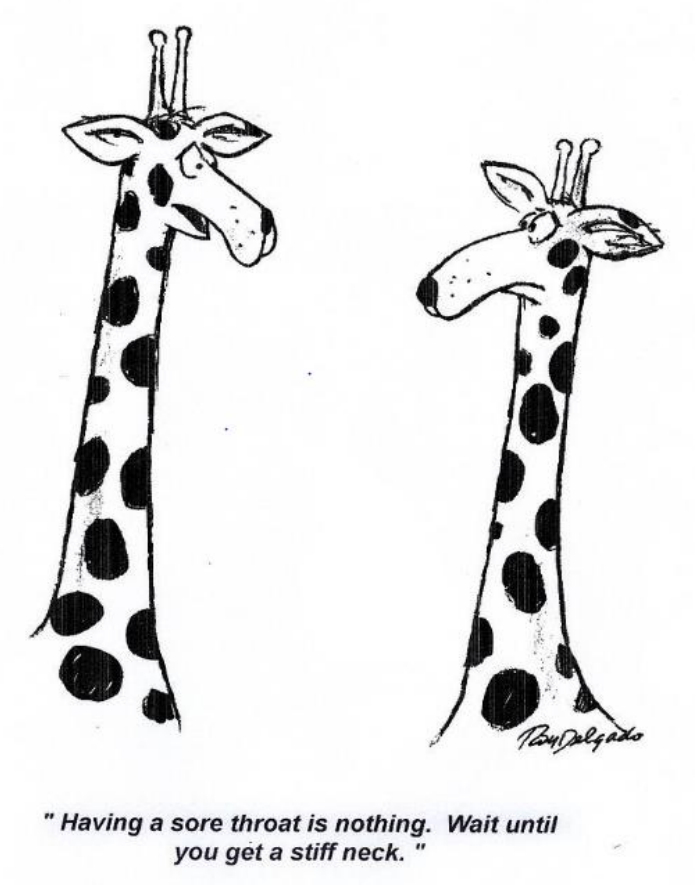
Yes
- Continue Methylprednisolone 30mg/kg/day IV † for up to 5 days
- **See Anakinra Management section for response & discontinuation criteria**
- Discuss additional therapy options with Rheumatology

No
- Afebrile
- Off vasoactive support
- Off oxygen
- Troponin & BNP trending down
- Downtrending inflammatory markers
- Tolerating PO
- **If applicable, Anakinra discontinuation criteria met**

After transfer to floor
- Ok to transition to Aspirin if no additional VTE risk factors present
  - If weight ≤ 15kg, 40.5mg PO daily
  - If weight > 15kg, give 81mg PO daily
- Repeat Troponin T and BNP every other day until normalized
- Repeat CRP on anticipated day of discharge for baseline
- Stop IV Steroids
- Start Prednisone or Prednisolone 2mg/kg/dose PO once daily
- Screen for Depression and Anxiety. Neuropsychology referral as outpatient
- Plan for taper over 6 weeks with Endocrinology referral (See steroid wean table)

† Max Methylprednisolone daily dose (2mg/kg/day) is 60mg/day
‡ Max 20-30mg/kg/day = 1 gram

[b] Max Anakinra dose = 100mg/dose. Continuous IV infusion requires a dedicated line due to lack of compatibility data.



Deep Neck Infections

- Peritonsillar Abscess
- Retropharyngeal Abscess
- Parapharyngeal or Lateral Space infection

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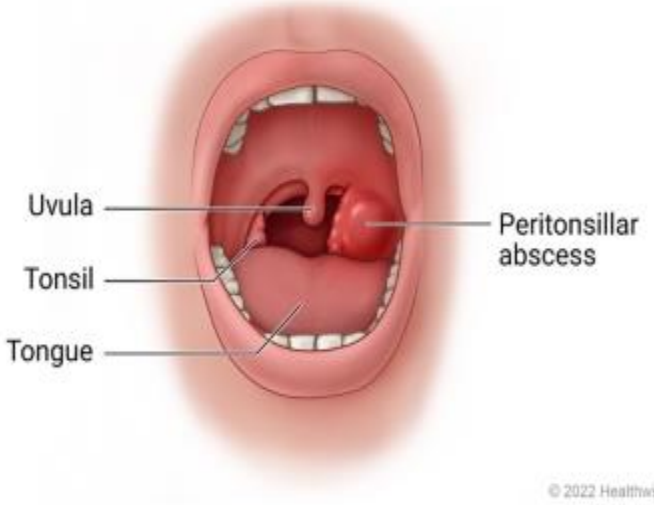
Peritonsillar Abscess (quincy)

- Presenting Symptoms and Exam:
  - Palatal fullness, often with exudate
  - Uvula deviation
  - Trismus
  - Muffled "hot potato" voice
  - Severe sore throat
  - Dysphagia and drooling
  - Fever
  - Sore neck and limited range of motion
  - Halitosis
  - Ipsilateral pain
  - Cervical lymphadenopathy



Peritonsillar Abscess

Medical History

- Tonsillitis
- Strep pharyngitis
- Viral respiratory illness
- Tooth infection
- Age of occurrence
    - More common in older children and adolescents

Common Bacteria

- Streptococcus pyogenes
- Staphylococcus aureus including MRSA
- Haemophilus influenzae
- Oral anererobs: Fusobacteria, Prevotella, etc
- -Infections are often polymicrobial!

Peritonsillar Abscess

Diagnosis:

- Physical Exam and health history can often be enough
- Ultrasound of Soft Tissue of the Neck
- CT of the Neck with Contrast-Gold Standard, not always needed!
- Labs? -> Gram stain and cultures-> if possible!

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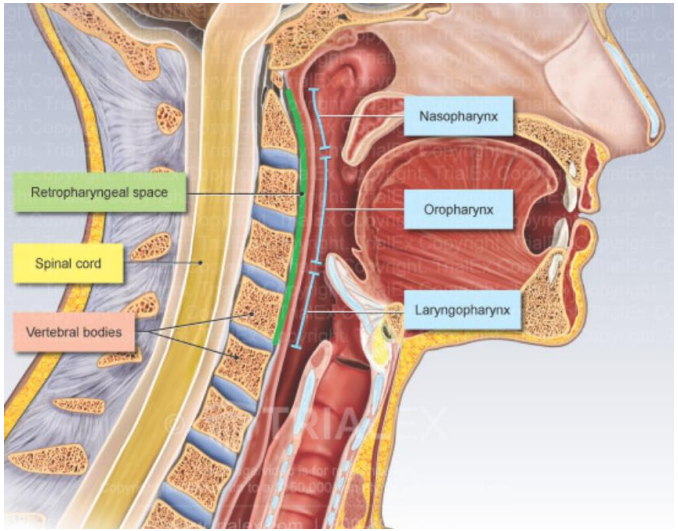
Peritonsillar Abscess

Treatment:

- ENT consult with possible bedside needle aspiration/I&D
- Antibiotic therapy: empiric therapy tailored to pathogen, strep pyogenes universally susceptible to penicillin, titrate to sensitivities
    - IV antibiotics when admitted: 1st line- Unasyn IV, Clindamycin IV (PCN allergy)
    - Oral antibiotics: Augmentin, Clindamycin
- Supportive Care: hydration, steroids, pain control
- ENT referral for elective tonsillectomy

Retropharyngeal Abscess

- Suppurative bacterial infection of the retropharyngeal space
- Where is the retropharyngeal space?
  - Area between the pharynx and cervical vertebrae that extends from the skull into the superior mediastinum
- Most common age group: young children age 2-5! But why?
  - Lymph nodes!
  - Usually follows URI infection
- If it occurs in order children & adults:
  - Usually due to trauma in posterior pharynx
  - Tooth infections (less common)



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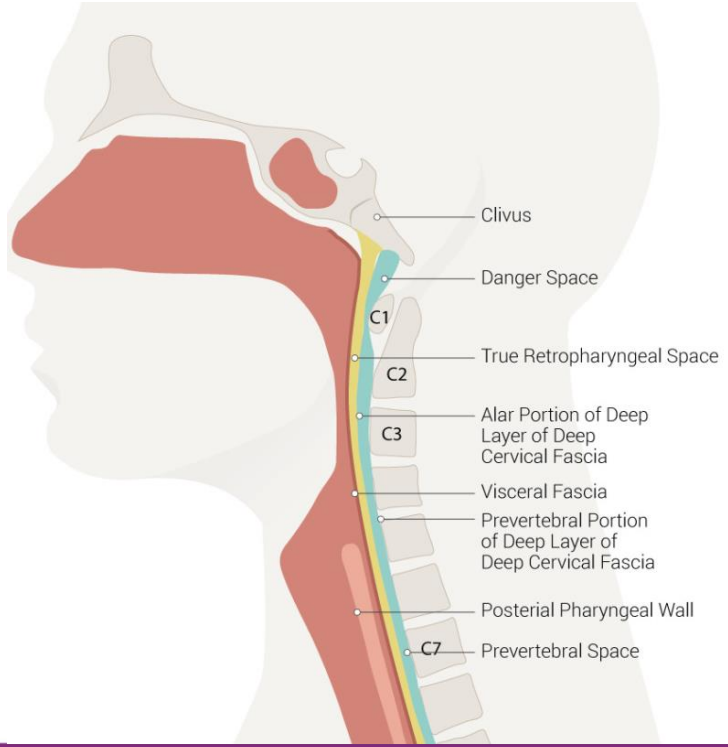
Retropharyngeal Abscess



Presenting Symptoms and Exam:

- Moderately ill appearing
- Fever
- Limited ROM in neck, stiffness, pain
- Neck swelling in neck may or may not be present
- Cervical lymphadenopathy common
- Dysphagia, pain with swallowing
- Hot potato change in voice
- If respiratory dsitress, stertor, stridor, or tripod posture consider an emergency!

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Retropharyngeal Abscess

- Diagnosis
  - Lateral neck x-ray but does not distinguish abscess vs phlegmon vs cellulitis
  - CT soft tissue of the neck with contrast is Gold Standard
  - Labs: not necessary for diagnosis but helpful if concerned for sepsis or to assess severity of infection/inflammation (CBC, CRP, adding blood cultures if concerned for sepsis)
  - ENT consult in ED/inpatient: determine monitoring on IV antibiotics vs I&D
  - Airway compromise is an emergency

Retropharyngeal Abscess

Common Bacteria

- Group A streptococcus
- Staphylococcus aureus including MRSA
- Haemophilus influenzae
- Oral anererobs: Fusobacteria, Prevotella, etc
  - Infections are often polymicrobial!

Treatment- Antibiotics/Surgery

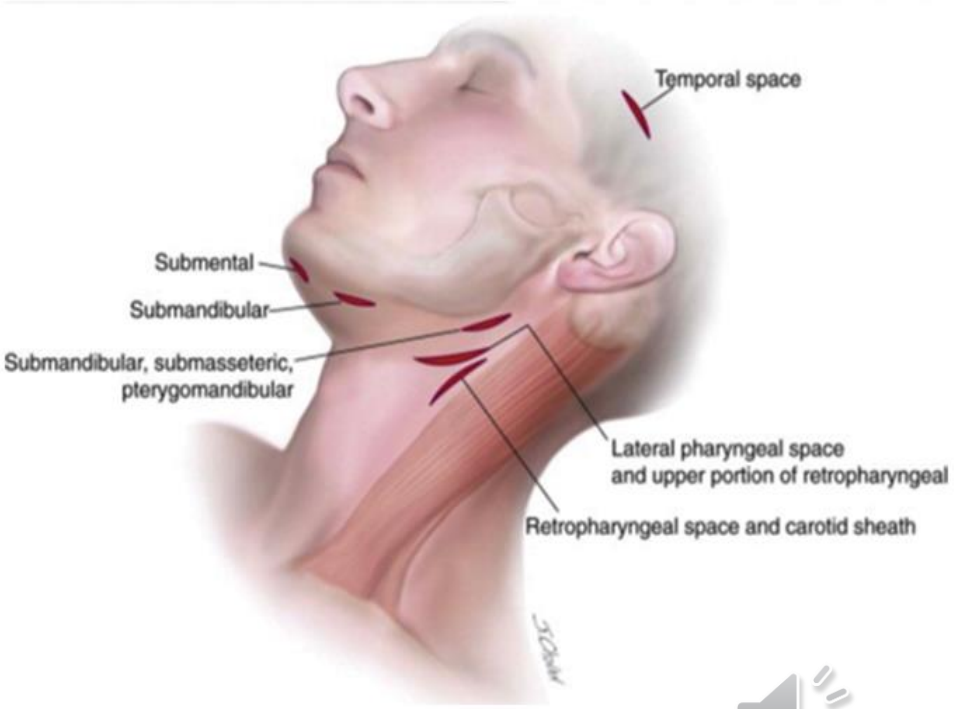
- Ampicillin/sulbactam (Unasyn) IV
- Clindamycin if concern for MRSA or PCN allergy
- If concern for sepsis:
- Unasyn AND Vancomycin
- Treat for 24-48 hours with IV.
- Goal for change to oral regimen:
- Improvement in overall symptoms (neck swelling, movement) and fever improvement
- Treat for total of 14 days (IV & oral)
- Surgery: Incision and drainage with ENT, consider if > 2cm or any airway concern

Other Deep Neck Space Infections

Lateral Neck Space

Parapharyngeal Neck Space

Submandibular



Complications of Deep Neck Space Infections

- Ludwig's Angina
  - Rare, but emergent, quick spreading cellulitis that can cause airway compromise
  - Complication from infection in mouth, commonly from lower molar infection/abscess
- Lemierre’s Syndrome
  - Rare, but emergent
  - Suppurative thrombosis of IJ vein following recent oropharyngeal infection and bacteremia
    - Fusobacterium (F. Necrophorum)

Cellulitis

- Most common skin and soft tissue infection
- Skin (barrier to pathogens) is compromised
- Symptoms: skin with erythema, warm to touch, tender, bullae
- Bacteria: Group A streptococcus is most common
  - Staphylococcus aureus likely if golden crust present
  - Consider MRSA if risk factors exist
- Akron Children's Local Treatment Guidelines:
  - Purulent cellulitis or abscess, clindamycin
  - Cellulitis secondary to animal bite, Unasyn
  - MRSA concern or Clindamycin allergy, use Vancomycin
  - Consider abscess if area of fluctuance, rule out with ultrasound

References

- ACH COVID Inpatient treatment guidelines
- CDC study shows effectiveness of RSV immunization for infants | CDC Online Newsroom | CDC
- Respiratory syncytial virus infection: Prevention in infants and children - UpToDate

References

- Uptodate.com
- Amin, M. 2024. Viral, Bacterial, and mycoplasma pneumonia in kids. Educational video.
- CDC, Whooping Cough, updated January 2025
- Prasso, J. 2018. Post viral complications, Bacterial pneumonia. Pub Med.
- Robinette, E. 2024. Antibiotic Update for Acute Care NPs. Power Point presentation
- Stoffcho, C. 2018. Upper respiratory infection, Pneumonia and croup. Power point presentation
- Tunkel, J. John Hopkins Medicine: Ear infections in babies and toddler

Questions?

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